

IOWA DEPARTMENT
OF NATURAL RESOURCES
SOURCE WATER PROTECTION PROGRAM

SITE INVESTIGATION ADDENDUM
DUNLAP, IOWA



**Prepared by
IDNR Contaminated Sites Section**

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Introduction

This addendum report describes the field work conducted by the Contaminated Sites Section in February 2011. It is intended to expand on ground water results described in *Section V: Results of Source Water Site Investigation* of the Final Site Investigation Report. In April 2009, a Source Water Protection Site Investigation (SWPSI) identified multiple locations of elevated nitrate in ground water that could not be attributed to a known point source. To evaluate a potential point source located outside the estimated 2 year capture zone, the Source Water Protection Program Technical Advisory Team (TAT) approved supplemental field work to the SPWSI. The first action was to analyze ground water quality from wells of different depths and type located within and outside the estimated 2 year capture zone. The second action was to measure the draw down caused by pumping the city wells in selected monitoring wells that are completed in the Boyer River alluvial aquifer.

Sampling Parameters and Ground Water Contaminants

A set of field parameters were selected to ensure consistent ground water sampling methods. The parameters selected were pH, temperature, dissolved oxygen (DO), conductivity and total dissolved solids (TDS). The field parameters were monitored while wells were purged until the parameters stabilized for sample collection. The primary contaminants analyzed to characterize ground water quality were nitrate, sulfate, chloride and herbicides. These chemicals were selected because they are commonly observed in ground water and indicators of aquifer susceptibility to contamination.

Sample Collection Method

Ground water was sampled on February 10 and 22, 2011. The sampled wells included two monitoring wells, five observation wells, five private wells and the two public drinking water wells (Figure 1). Samples from the private wells were collected from outside spigots that do not pass through a water treatment system.

Ground water samples from monitoring wells MW7, MW7D and the Iowa Geological Survey (IGS) well were collected with a Proactive™ Tornado® model, portable electric pump. Water samples from the observation wells OW1, OW2, OW3 and OW6 were collected by inserting 5/8 inch (inside diameter) polyethylene tubing and were hand pumped using a Watera™ foot valve attached to the end of the tubing. All wells were purged until field parameters stabilized. Ground water samples were submitted for analysis to the State Hygienic Laboratory (SHL) and specific sample results are attached in Appendix 1. Ground water samples were also analyzed in the field by Contaminated Sites field staff using a Hach™ DR 2800 Spectro-photometer® for nitrate, iron, chloride, sulfate and dissolved oxygen (DO).



Figure 1: Sample locations within and outside revised 2 year capture zone from IGS Induced Recharge study. Corresponding sample results listed in table 1

Wells Selected for Sampling and Analysis

A total of fourteen wells were selected for sampling and analysis. Six wells are located within the estimated 2 year capture zone. They include four observation wells (OW1, OW2, OW3, and OW6) that are 50 feet deep and completed in the Boyer River alluvial aquifer. Dunlap city wells #3 and #4 were also sampled and are around 100 feet deep. They draw water from both the Boyer River alluvial aquifer and deeper Dakota bedrock aquifer. Well construction records for well #3 and #4 are attached in Appendix 2. Eight wells located outside of the estimated 2 year capture zone were sampled. Five of the eight wells are located south of the estimated 2 year capture zone. They are monitoring wells MW7, MW7D, the Crop Production Service (CPS) well, the Iowa Geological Survey (IGS) monitoring well and the Bonsell private well. All of these are completed in the Boyer River alluvial aquifer and range in depth from 27 feet to 92 feet. Three of the eight wells are located northeast of the estimated 2 year capture zone. Two of them (Bart Sullivan and Joe Sullivan) are reported to be at least 300 feet deep. The third well (Private Well #2) is reported to be of similar depth. These three wells are presumed to be completed in the Dakota bedrock aquifer. The results of the supplemental addendum ground water analyses for all 14 wells are summarized in Table 1.

Ground Water Data Interpretation

The alluvial aquifer in the Dunlap area is susceptible to nitrate contamination from both point source and non-point contamination. Ground water data that supports this interpretation are high nitrate concentrations observed in the observation wells OW1, OW2, OW3 and OW6, the elevated chloride and sulfate observed in monitoring well MW7 and elevated sulfate observed in the IGS well. Elevated chloride and sulfate, considered indicators of surface contamination, are relatively higher in the shallower wells.

The city wells are also susceptible to point source and non-point source contamination because, although they draw water from the deeper Dakota bedrock aquifer, they are dual completion wells and draw water from the Boyer River alluvial aquifer. The city wells also have a history of elevated nitrate however it is generally below levels observed in the shallow observation wells and has not risen above the nitrate drinking water standard of 10 mg/L. The Bart and Joe Sullivan wells and Private well #2 that are completed in the Dakota aquifer have greater protection from nitrate. They appear to be less susceptible to contamination based on lower nitrate concentrations as well as lower iron, chloride and sulfate relative to the shallow alluvial aquifer.

The IGS well and the Bonsell well are located southwest and west of the CPS facility and have high nitrate. The Bonsell well is also impacted by herbicides (Acetochlor, Metolachlor and Atrazine) but at levels below their maximum contamination limits (MCLs). The Bonsell well also has the highest sulfate concentration (67.80 mg/L) of all the wells tested. The presence of herbicides, elevated nitrate and sulfate indicates the alluvial aquifer in the vicinity of the CPS facility is contaminated.

The susceptibility of the alluvial aquifer to contamination is also supported by the ground water monitoring results of an ongoing investigation of the CPS facility that is under the direction of the IDNR Contaminated Sites Section. This site investigation had determined the direction of shallow ground water flow in the alluvial aquifer at the CPS facility to be to the southwest toward the Boyer River. Several wells in the CPS facility investigation also have elevated nitrate in the alluvial aquifer. The deeper CPS well however has exhibited low nitrate concentration. This may be because the CPS well is utilizing clean water from the deeper more protected Dakota bedrock aquifer, or that nitrate released from the facility has not reached the deeper portion of the alluvial aquifer and caused nitrate levels to rise. A summary of analytical results are presented in Table 1.

Table 1: Data in red exceed maximum contamination level (MCL) or secondary maximum contamination level (SMCL). Data in yellow are considered elevated or significant. Corresponding State Hygienic Lab analyses are attached. NS= no sample, ND= not detected, NA = no applicable standard.

Samples collected 2/10, 22/11 location/well depth/aquifer	Chemical Contaminants							Field Parameters				
	NO3 (SHL)	NO3 (DNR)	Iron	Chloride	Sulfate	DOC	Herbicides	DO	pH	TDS	temp	Cond
OW-1 (50ft)/alluvial	NS	5.13	89	41.8	23.7	<0.5	NS	12.8	7.09	312	51.7	733
OW-2 (50ft)/alluvial	NS	22.4	0.168	59.2	35	<0.5	NS	8.4	7.66	518	ND	1034
OW-3 (50ft)/alluvial	NS	12	140	4.3	29.3	<0.5	NS	8.4	6.82	488	53.4	976
OW-6 (50ft)/alluvial	NS	7.66	0.143	20	59.9	<0.5	NS	5.7	6.81	528	51	1057
MW-7 (27ft)/alluvial	7.3	7.41	0.21	510.00	1.68	NS	NS	10	6.3	1275	52.8	2553
MW-7D (56ft)/alluvial	<0.10	0.2	0.11	14.60	23.00	<0.5	No detect	0.9	7.13	409	51.5	820
IGS well (60ft)	4.9	6.26	0.074	15.00	48.20	<0.5	Acetochlor 0.25	<0.5	6.66	406	54.6	806
							Metolachlor 22					
							Atrazine 0.27					
Bonsell well (92ft) bedrock	5.6	6.63	<0.02	NS	67.80	<0.5	ND	2	7.19	440	49.3	888
City Wells #3(97 ft) dual completion	6.2	7.98	0.01	9.7	17.3	<0.5	ND	6.6	7.18	366	51.7	731
City Well #4 (103) dual completion duplicate (Fe)	0.12	3.9	(0.766)	1.3	11.2	<0.5	ND	1	7.28	339	51	665
	NS	NS	(0.669)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Private well #2 (depth unknown)	<0.10	0.847	0.035	0.6	29.9	NS	NS	NS	7.06	320	48.8	640
Bart Sullivan Well (290ft.) bedrock	<0.10	0.483	0.025	0.7	17.4	NS	NS	NS	7.08	314	52.1	630
Joe Sullivan well (300 ft) bedrock	<0.10	0.32	0.194	0.2	9.7	<0.5	NS	0.9	6.97	279	51.3	565
CPS (depth unknown)	<1.0	NS	0.068	1.4	1.1	NS	ND	1.4	7.33	297	45	596
MCL/ (secondary MCL)	--	10	0.3	250	250	1 to 20	3/700/140	NA	6.5-8.5	500	NA	NA
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L		PPM	F	mS/L

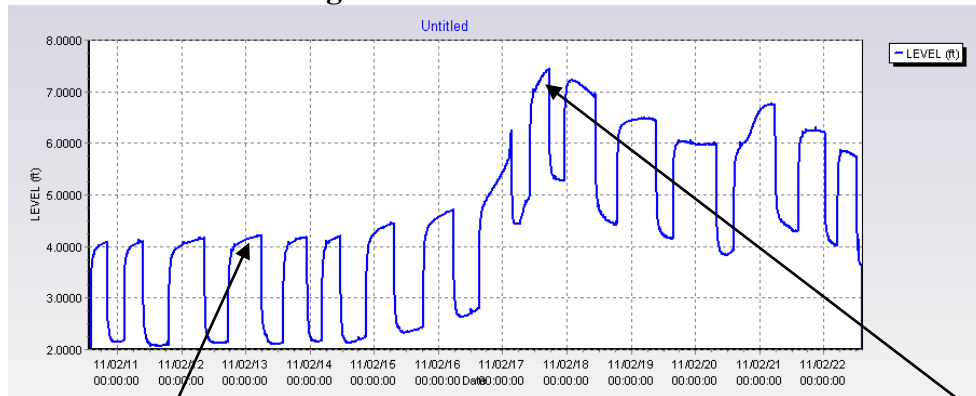
Discussion of Ground Water Level Data

Ground water level data were collected by pressure transducers placed in four monitoring wells to evaluate the effect of pumping at different locations with increasing distance between the city wells and the CPS facility. This would increase the understanding of the potential nitrate impact to the city wells from the CPS agricultural facility. The four wells that received transducers were observation well OW6 that is located immediately next to the city wells, monitoring wells MW7 and MW7D co-located 1000 feet south of city wells #3 and #4 on the north end of CPS property and the IGS well located 1500 feet south of city wells between the CPS facility and the Boyer River. All of these wells are assumed to be completed in Boyer River alluvial aquifer.

The transducers were operational for 13 days from February 10 through February 22, 2011. During the transducer test the only well being used was city well #3 that operated at a (reduced) pumping capacity of 220 gallons per minute (GPM). During the 13 day test period measurable draw down was observed at three of the four wells with transducers. Sixteen distinct synchronized pumping cycles were noted (figure 2). The pumping cycles were distinguishable at monitoring well MW7D and the IGS well however the amplitude of the cycles was significantly reduced with increasing distance from the pumping center (city wells). There was no measured response to pumping detected at shallow monitoring well (MW7) despite being co-located with well MW7D. Monitoring well MW7 is only 27 feet deep and completed at the ground water table. The lack of measured response to pumping at just that one location indicates the shallow water table at that location may have very poor hydrologic connection to the Boyer River alluvial aquifer.

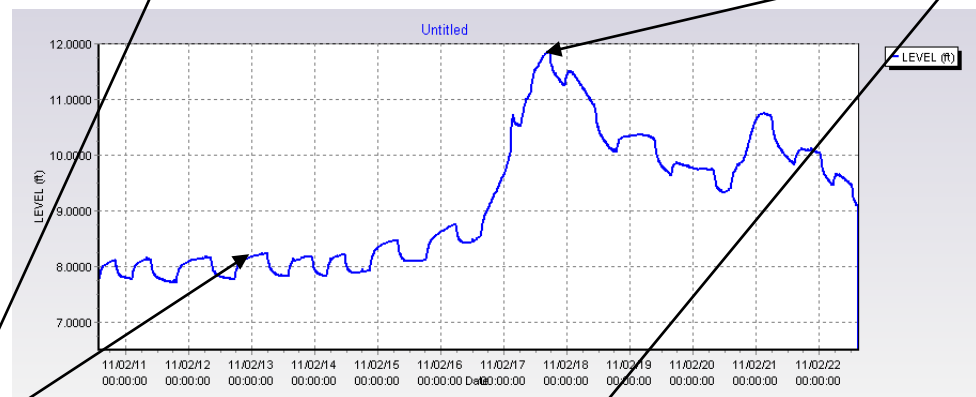
During the monitoring period there was also an apparent infiltration event caused by snow melt that was detected by all four of the transducers on February 16th 2011 which peaked on the 18th and another infiltration event on the 21st. These infiltration events demonstrate rapid and direct response by the alluvial aquifer to surface infiltration (if not pumping) and potential susceptibility to surface contamination.

Figure 2: Transducer results



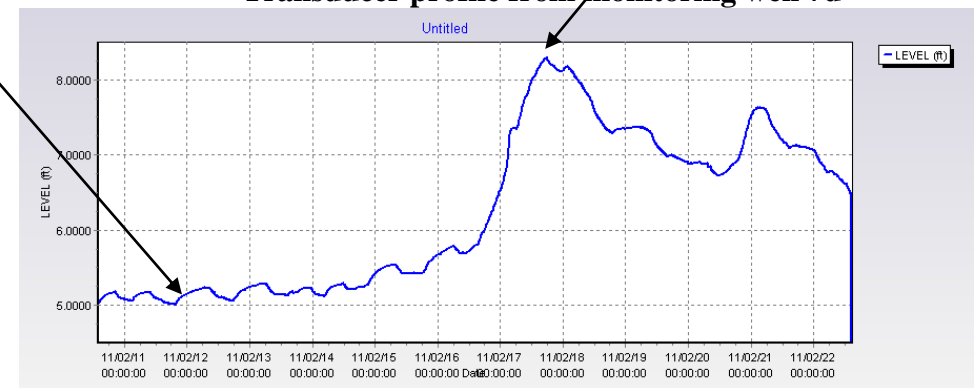
Transducer profile from observation 6 near city wells 3 and 4

Major peaks from infiltration event

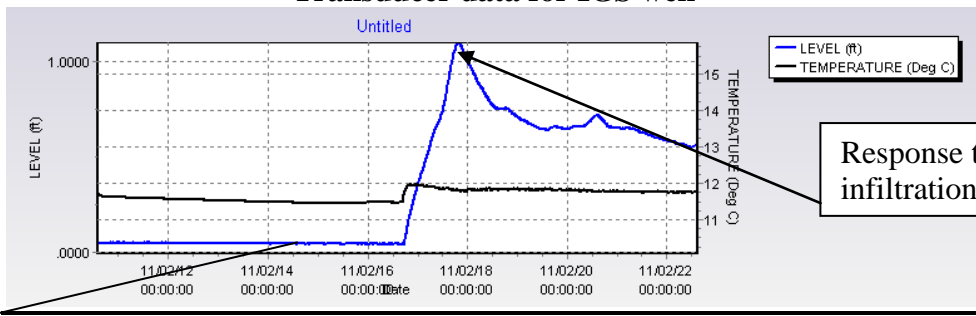


Transducer profile from monitoring well 7d

Saw tooth pattern indicates pumping and resting cycles



Transducer data for IGS well



Response to infiltration

No response to pumping

Transducer profile for MW7

Conclusions

- **Extended ground water sampling outside the estimated 2 year capture zone identified three additional wells (MW7, the IGS well and Bonsell well) that are impacted by nitrate and/or herbicides. The data supports the previous assumption that the Boyer River alluvial aquifer is highly susceptible. The probable source of the contamination is the CPS facility.**
- **The water quality observed in the Bart Sullivan well, Joe Sullivan well and Private well #2 demonstrates lower susceptibility of deeper Dakota bedrock aquifer.**
- **The draw down observed in MW7D (located on the CPS property) and in the IGS wells demonstrated the potential for point source contamination from outside the estimated 2 year capture zone is greater than was originally believed.**
- **The susceptibility of the Boyer River alluvial aquifer has been confirmed through ground water sampling and draw down responses in wells on and near the CPS facility however, no traceable nitrate plume between CPS and the city wells was discovered.**

Appendix 1:

State Hygienic Laboratory Ground Water Analytical Results

Appendix 2:

Well Construction Records for Dunlap City wells #3 and #4